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Low Birth Weight in Nigeria:
Does Antenatal Care Matter?

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Abstract

Population-based studies that include women who use both modern and traditional maternal health care are necessary to identify factors associated with the size of a baby at birth. This study examines the role of antenatal care on small size at birth based on the 2003 Nigeria Demographic and Health Survey data. The study finds that antenatal care as measured by tetanus toxoid injections and women who were provided guidance on where to go for pregnancy complications (a proxy for antenatal care) are associated with lower odds of giving birth to small-sized babies suggesting that the content of antenatal care is important in judging its quality and effect. Beyond antenatal care, a predominant factor associated with size of baby at birth is maternal nutritional status. Women with higher weight for height scores (>120) and taller mothers (>160 cm) had a lower incidence of small size at birth, whereas shorter maternal stature increases the risk of small birth sizes. The odds of small birth size are lower among women of high socioeconomic status (SES) in urban areas which is attributed to the expected positive correlation between SES and the utilization of antenatal care services. However, in rural areas, even poorer women had lower odds of the incidence of small birth size, as compared to poorest women implying that in addition to SES, antenatal care had a direct effect on size at birth in rural areas. Inter-regional comparisons also indicate that women in urban north-central and south-south parts of Nigeria were more likely to deliver small babies as compared to those in the south-west. But women in the north-west, living in rural areas, were less likely to deliver small babies compared to those in rural south-south. The findings suggest that selectively targeted interventions such as maternal education, maternal nutrition, routine tetanus toxoid injections and advocacy programmes aimed at mobilizing religious leaders as agents of sensitization and change may help in ensuring adequate care and better birth outcomes in their respective communities taking regional disparities into consideration.

Chapter 1

INTRODUCTION

One of the poor outcomes of pregnancy that has caught the attention of the World Health Organisation (WHO) is low birth weight. This is defined as weight at birth less than 2500g (5.5pounds). This practical cut-off for international comparisons is based on international epidemiological observations that infants weighing less than 2500g are approximately twenty (20) times more likely to die than heavier babies (WHO and UNICEF 2004). Low birth weight below 2500g is common in the developing world as it contributes to a range of poor health outcomes. Reducing low birth weight incidence by at least one-third between 2000 and 2010 is one of the major goals in "A World Fit for Children", a declaration and plan of action adopted by the United Nations Organisation (UN) general assembly special session on children in 2002 and is also a contributor to the Millennium Development Goal (MDG) of reducing child mortality by 2015. It is thus an indicator for monitoring the achievement of these goals. Any long term strategy for reducing infant mortality will require improvement in factors that affect birth weight (UNICEF 2001, 2003).

An infant's weight at birth is an important indicator of maternal health and nutrition prior to and during pregnancy and a predictor of infant growth and survival (refer to figure 1). There is an increased morbidity and mortality, impaired immune function, and poor cognitive development among neonates who were born with low birth weights (Ashworth 1998, Chandra 1999, Iyasu et al. 1992, Paneth 1995, Rahan & Tafida 1981).

Every year, 17 million infants in developing countries are born with low birth weight (Pojda and Kelly 2000), and there are little chances of reaching full growth potential for infants who manage to survive. UNICEF[1] estimates show that in Nigeria, the percentage of low birth weight infants is 14, adjusting for both mother's assessment and heaping on 2500g, yields higher estimates of the incidence of low birth weight (WHO & UNICEF 2004). The prevalence of low birth weight is Nigeria has been put previously at 16%, 9% and 12% (UNICEF 2001, 2003). Every single day, Nigeria loses about 2,300 under-five year olds. This may be associated with the incidence of low birth weight in the country, thus making the country the second largest contributor to under-five mortality in the whole world (UNICEF, 2008). In Table 1, I present the incidence of low birth weight for selected African countries as compared to the average for industrialized countries.

[1]http://www.unicef.org/infobycountry/nigeria_statistics.html

Table 1
Incidence of low birth weight in selected African countries

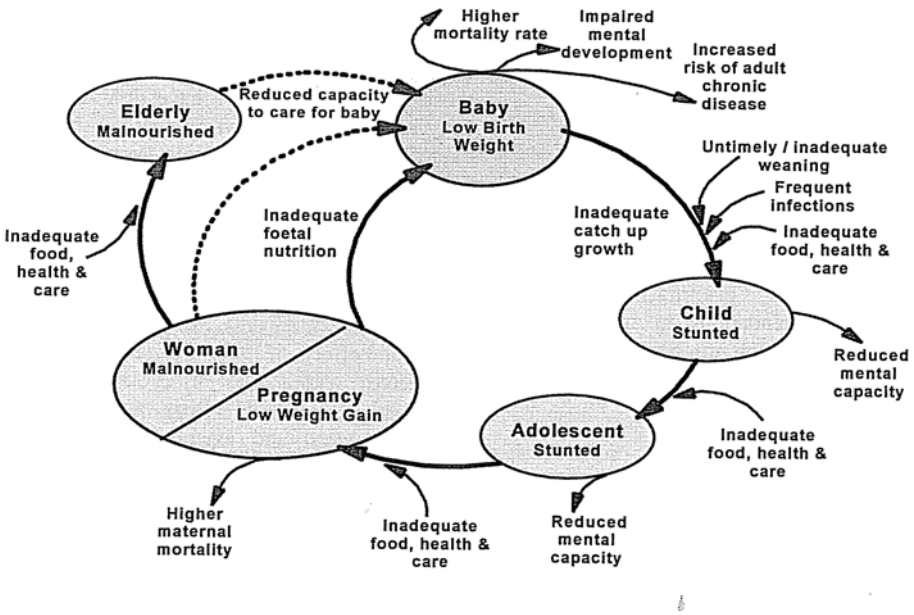
Country	% of low birth weight infants	Year
Nigeria	14	2003
Ghana	9	2006
Gabon	14	2000
Tanzania	10	2004-2005
Botswana	10	2000
Angola	12	2000
Rwanda	6	2005
Mali	23	2001
Industrialized countries	7	

Source: UNICEF 2008

Low birth weight is a concept developed and used by epidemiologists and public health practitioners and its popularity (Kramer 1998) is tied to infant mortality (particularly neonatal) which rises exponentially at birth weights below 2500g. It is often used as a proxy indicator to quantify the magnitude of inter-uterine growth retardation (IUGR) in developing countries because valid assessment of gestational age is unavailable.

This study is motivated by the incidence of low birth weight in Nigeria, and the persistent negative consequences associated with low birth weight which may be contributing to chronic diseases and health complications in the course of a child's growth (see figure 1).

Figure 1
Nutrition throughout the lifecycle framework



Source: Commission on the Nutrition Challenges of the 21st Century (2000) Final report to the ACC/SCN.

Preterm births and IUGR are the two main causes of low birth weight. From a clinical view point, low birth weight is not a very useful outcome as it is a function of two factors; duration of gestation (preterm birth) and rate of

foetal growth (growth restricted). The two of them exhibit rather vast differences in prognosis. The occurrence of low birth weight in developed countries is due to preterm birth whereas in developing countries it is mostly caused by IUGR (Kramer 1998). Thus the medical causes and effects of low birth weight are complex and they often centre on the foetus, placenta, the mother and a combination of all three. The multiplicity of these medical causes and effects are best considered within the lifecycle conceptual framework (figure 1).

Poor nutrition most times begins *in utero* and extends through out the life cycle. This heightens the risk to the individual's health and increases the likelihood of damage to future generations through further foetal under-nutrition. Under-nutrition, which is manifested in short maternal height and below-normal pre-pregnancy weight and pregnancy weight gain consists of the strongest predictors of giving birth to a low birth weight infant. Noting the potential influence of nutritional status of the mother on the health and survival of her child is important because of the biological link between her and the infant during pregnancy and lactation (Ogunjuyigbe et al. 2008). Although the relationship between maternal nutrition and infant mortality is complex, it can be explained through maternal weight gain in pregnancy and birth weight of the infants.

Prenatal care received by pregnant women has been identified as a means of identifying mothers at risk of preterm or growth-retarded infants and to provide several available medical, nutritional and educational interventions intended to alleviate the incidence of low birth weight and other adverse pregnancy outcomes. It has many aspects including at a minimum when it starts, the number and spacing of the visits, the content of each visit, the type of provider (e.g. doctors, midwives, traditional), the provider setting (for example; hospital, clinic or home), the assessment of risk status, the schedule of medical screening tests, and the use of specific medical, educational, nutritional and social support intervention services (Alexander and Korenbrot 1995).

The objective of this study is to examine the determinants of low birth weight and specifically to identify the impact of antenatal care on low birth weight with and without controlling for socioeconomic indicators of the mother. Previous studies on determinants of low birth weight in Nigeria have found that reproductive loss, preceding birth interval, education and maternal nutrition (Ebomoyi et al. 1991, Ogunjuyigbe et al. 2008), females infants and rural women (Rahan and Tafida 1981) and maternal age (Ozumba and Okafor 2006) were significantly associated with the incidence of low birth weight. These studies have been based on hospital statistics. A hospital birth may indicate higher income and therefore better nutrition or it could indicate a higher-risk birth, possibly skewing the data on birth weights downward. This is a serious limitation in developing countries where most births do not occur within the health facilities (Asghar 1999). The results of hospital-based studies in communities where a substantial proportion do not have access or use modern health facilities are subject to selectivity bias and cannot be generalised to the entire population and therefore must be treated with caution.

In such studies, including women who use modern as well as traditional forms of health care are necessary to identify those factors associated with poor pregnancy outcomes. There is therefore a need for a thorough analysis of how antenatal care affects low birth weight. Beyond what these past studies on

Nigeria have shown, this study aims to estimate the association between antenatal care (antenatal care quality, content and maternal morbidity status) and low birth weight, controlling for socioeconomic factors using a more recent survey; the 2003 Nigerian Demographic and Health Survey (NDHS) which takes into consideration these limitations of hospital-based data. Moreover, taking the general paucity of data and incompleteness of birth-weight information (UN 2004) in Nigeria into account, this study intends to explore the possibility of using birth-size as equivalent measure/proxy for birth weight. The successful use of birth size may provide new avenue for understanding determinants of birth weight with both theoretical and practical implications.

This study is sub-divided into five main chapters. Chapter two provides a description of the study area and discussions on health outcomes and antenatal care in the Nigerian context. Next, I examine some theories surrounding the determinants of low birth weight based on existing studies. This will be used to build an analytical framework surrounding this birth outcome. In chapter four, I shall discuss the data and methods of analyses adopted for exploring the determinants of low birth weight. Chapter five discusses results of my econometric work. In chapter six, I shall summarise, present conclusions, as well as discuss possible policy implications.

Chapter 2

NIGERIA: ANTENATAL CARE, MATERNAL NUTRITION AND LOW BIRTH WEIGHT

2.1 Public expenditures and health outcomes in Nigeria

Nigeria has the largest population (about 140 million) amongst all the African countries, with more than half of its population living in rural areas. There are 250 ethnic groups of which Hausas dominate in the north, Ibos in the east and Yoruba in the west. Majority of the population in the North are Muslims and in the south, east and west are Christians. The northern states comprises of more homogenous Hausa speaking population. Other none northern states are less homogenous and made up of diverse ethnic groups with diverse socio-cultural patterns of life. There is an increase in the proportion of Christians, spiritual churches and practicing traditionalists in the southern regions. A rise in both Christian and Muslim fundamentalism associated with the introduction and adoption of the Sharia Islamic penal codes by ten core northern states in 1999, curtailed the human rights of Muslim women (DFID 2005). Women under these Sharia laws are excluded from decision-making in areas related to their health and denied opportunities to influence decision making on issues of health[2].

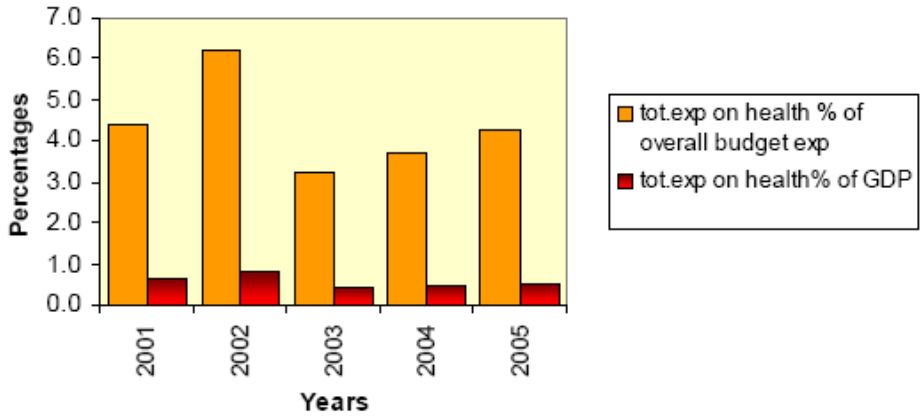
Nigeria is the seventh–largest crude oil producer in the world with substantial mineral and agricultural resources. Amidst Nigeria's immense human and natural resources, little progress is being made in terms of health status and survival of children and mothers. In 2000, the WHO ranked the performance of Nigeria's health care system 187 among 191 United Nation's member states (WHO 2000)[3]. It was placed on 148/174 on the Human Development Index in 2002. The 2003 Nigerian Demographic and Health Survey (NDHS) show that the incidence of low birth weight has not changed much from 1990 to 2003. The absence of a substantial reduction in the incidence of infant mortality in the country may be explained by the stagnated incidence of low birth weight in the country. Sixteen percent (16%), 14% and 14% of babies in the five years preceding the survey were reported by their mothers to be very small or smaller than average at birth in 1990, 1999 and 2003 respectively. There is thus a need to find out what factors determine low birth weight in the country.

The quality of maternal health care facility in Nigeria is poor; this may be because general government per capita expenditure on health amounted to only five dollars in 2002, far below WHO minimum recommendation (WHO 2000). Health expenditures have on average been on the decrease and that may explain why Nigeria's health systems performance scores are low. Below I present data on total expenditure on health as a percentage of overall budget expenditure and GDP from 2001-2005.

[2] The recent Core Indicators Cluster Survey for Jigawa, a northern state shows that 81% of male heads of households took decisions on health matters alone. A similar distribution was observed for decisions on education, clothing and food expenses.

[3] http://www.who.int/whr/2000/en/

Figure 2
Total expenditure on health as % of overall budget expenditure and GDP[4]



The federal government of Nigeria's budgetary expenditure on health sector remained at an average of 4% of overall budget expenditure and as a percentage of GDP remained below 1% between 2001 and 2005. However when expenditures on National Programme on Immunization and MDGs-health-related spending are added, the expenditure figures are higher (see Table 2).

Table 2
Government expenditure as a percentage of GDP in Nigeria (2000-2003)

Year	2000	2001	2002	2003
Percentage of GDP on health expenditure	1.4	1.7	1.3	1.3

Source: World Bank database 2004

But when compared to other countries, Nigeria performs poorly. For example a United Nations report in 2004 shows that both private and public expenditures as a percentage of GDP on health is 2.6 and 0.8 respectively. Only 2.2% and 3.4% of the total expenditures was spent on health in 2000 and 2001 which is very low when compared to 8.6% spent in South Africa.

Some policies by the Nigerian government such as the National Health Insurance scheme proposed in Nigeria in 1962 under a bill introduced to parliament by the then federal minister of health failed. However, in 1999, this bill was again passed into law in which benefits to be provided by the scheme includes among others antenatal and postnatal care and maternal reproductive health services. Contributions from citizens by way of regular payment to the scheme and financial property, provision of adequate and essential drugs by Health centres for these programs are important towards the success of this program (WHO & UNICEF 2004). Another laudable health policy by the Nigerian government was the establishment of primary Health Care Centres (PHC) in villages and communities in the late 1980s. This has helped to bring health nearer to the people, but again provision of experts and manpower is dragging the wheel of progress of this program.

[4] http://siteresources.worldbank.org/NIGERIAEXTN/Resources/7Point_Policy_Nigeria.pdf

2.2 Prenatal care in Nigeria: Availability and accessibility.

There is a public health care system that includes federal, state and community hospitals, clinics and health centres. The states and local governments take responsibility for the financial aspects of the secondary health care and primary health care departments in the country. In addition, a large component of health care is provided in private fee-for-service centres usually with some beds, which are often referred to as clinics or hospitals. No clear distinction exists in the private sector between physician practices, clinics and hospitals (Henshaw et al. 1998).

Fatusi and Ijadunola (2003) of 12- randomly selected states revealed that only 18.5% overall and only 4.2% of public facilities met internationally accepted standards for obstetric care. Approximately, three-quarters of the rural women and two-thirds of all Nigerian women deliver outside of health facilities in the absence of medically-skilled attendants (NDHS 1999, 2003). Based on USAID report in 2001, sixty-seven percent (67%) of Nigeria's population has access to health care services from 1990-2000 compared to a country such as Burundi with 80%. In 2002, percentage of population with access to sanitation facilities was 48% and 30% respectively for urban and rural areas which is low compared to the 1990 rate (50% and 33% respectively). This dismal state of the health sector in the country contributes to adverse birth outcomes.

Since the year 2000, several health programmes geared towards maternal and child health have been taking place in different states of Nigeria. They include; Department for International Development (DFID) funding for PATHS; a seven-year project aimed at strengthening Nigeria's health care systems at the state levels with a target on safe motherhood, United States Agency for International Development (USAID) in the most recent country strategic plan pledged above $10 million dollars to safe motherhood initiatives, the World Bank did approve several loans for the health sector by providing finance which is applied towards achieving the millennium development goals and better pregnancy outcomes in particular (Duby 2004).

Others include the MacArthur and Packard Foundations, that have supported NGOs and civil society leaders in maternal mortality reduction programmes, Centre for Development and population activities (CEDPA)-project aimed to improve the reproductive health status of women and men of child bearing age in the northern part of the country, Engender Health's project to improve access to family planning methods and Pathfinder International's Integrated Health and Education, Safe Motherhood, Reproductive Health and Family Planning and ENHANSE[5] projects. The latter focuses on the training and sensitization of Muslim leaders in Nigeria's Muslim-dominated north. The Rotary Foundation from 2002 has been involved in an Improvement of Maternal Health care project in Northern Nigeria. Ondo state in Nigeria, launched "Health Rangers" rural health services to carry primary health care to rural areas of the state, British Airways made available some $455,000.00 to UNICEF under its poverty alleviation programme (for health care delivery, advocacy in reproductive health, training of traditional birth attendants) in Lagos state of Nigeria.

[5] Pathfinder offers trainings and sensitization of religious leaders (Imams) in the Muslim–dominated North on socio-cultural issues such as: reproductive health and child survival, safe motherhood and basic education.

Health services provisions are funded mainly through the federal revenues. In the 1990s, some governments in the south western part of Nigeria claimed to provide their constituents with "free medical care" but they fail to add that a social/welfare service in health provided free of direct costs constituents attracts an increase in cost in other services or self-funding at a higher cost of services which the government could have provided at a cheaper cost (Odutola 2001). Sixty-one (61%) of women have access to information on danger signs and pregnancy complications. Seventy-one (71%) and thirty-eight (38%) percent (NDHS 2003) of women in urban and rural areas respectively make four or more visits to antenatal care provider and 37% did not make any antenatal care visit. Content of antenatal care visit vary by place of residence in Nigeria. Urban women had better contents than rural women.

Problems associated with the deplorable state of the Nigerian Health care system are; low motivation for health professional workers, corruption and little consultation between federal and state health ministries and between the federal ministry and other ministries. The negative side of the inadequate health services system in Nigeria also stems from factors such as ignorance, apathy, poverty, lack of commitment, illiteracy and corruption with impact on health and development (Okereke et al. 2005). There is a high shortage of health workers in Nigeria and many have emigrated for social and economic reasons. About 41% of service days (155 out of 365 days) in the year 2000 were lost to a wage-related nation-wide strike consisting of health workers including resident doctors and midwives. Health service-delivery were paralysed in all public/government hospitals between September and December of that year. The economic and human cost of this strike must be high if quantified nationally. More so, most of the health personnel in Nigeria prefer to work in private hospitals and among those in the public/government hospitals, a large number of them prefer not to work in rural areas. The 2003 DHS also shows that only 36.7% of the births were attended to by midwives and 21.3% by doctors. 36.9 of the women were not attended to by anyone, possible because there were no prenatal care services available or some socioeconomic factors may have deterred their attendance.

Kabir et al. (2005) in northern Nigeria have found that mother and father's education were determining factors for the utilization of antenatal care. But (Ibeh 2008) have shown that in an eastern state (Anambra) of Nigeria, even in few cases where antenatal care services were available and utilized, the problem with the pregnancy outcomes depended on the quality of care received. Although late and inadequate antenatal care may be explained by cost, Peltzer and Ajegbomogun (2005), who studied the utilization of antenatal care in a Nigerian Teaching Hospital found that the sampled women began antenatal care late (mostly in the third trimester) even when antenatal care was free. Poor women were 63% less likely to visit for professional antenatal care, 73% less likely to visit a doctor and 37% less likely to visit a nurse/midwife or antenatal care. An antenatal care visit may be the first and only point of contact with health care system to some women in Nigeria. This statistics of course differ between regions.

Women's perception of their pregnancy will reflect their cultural background and status within the family and community. Even when pregnant women gain access to antenatal care, the conflict with traditional and cultural views on suitable medications for use in pregnancy is a considerable factor affecting their utilization. Religion in Nigeria determines health care access and

utilization especially for religiously and traditionally inclined women. The Northern part (Northeast, Northwest and North central) of Nigeria are Muslim-dominated. In such regions, women's status in relation to their access to antenatal care is generally low and that may explain why the incidence of low birth weight is higher in these regions based on the 2003 NDHS. Therefore, the beliefs among pregnant women in relation to disease and antenatal care need to be understood if antenatal care services are to have their optimum impact.

Chapter 3

DETERMINANTS OF LOW BIRTH WEIGHT

3.1 Low birth weight and prenatal care:

Low birth weight defines a heterogeneous group of infants. Some are born early, others born growth-restricted and the others born both early and growth–restricted. In the general sense of it, low birth weight is a disadvantage for the baby. Available studies (Greenberg 1983) have revealed variations in birth weights among different populations with different economic, biological, physical and social conditions. There is thus a quest for a standard of reference for birth weight appropriate for developing countries where such data are not readily available.

Antenatal care is globally accepted and commonly understood to have a beneficial impact on pregnancy outcome, either through the detesting and treatment of complications or by contributing to the reduction of modifiable maternal risk factors. It is a means of identifying mothers at the risk of delivering a preterm or growth retarded infant and to provide an array of available medical, nutritional and educational interventions intended to reduce the risk of low birth weight and other adverse pregnancy outcomes (Ahmed and Das 1992, Alexander and Korenbrot 1995, Bloom et al. 1999, Hollander 1997 & Magadi et al. 2000). Early antenatal care initiation has been associated with heavier birth weights (Eisner et al. 1979, Gortmaker 1979, Greenberg 1983, Showstack et al. 1984). It has also been identified as the central link between various socio-demographic factors and birth outcomes (Magadi et al. 2004). However, the efficacy (Mustard & Roos 1994) of antenatal care as a primary or secondary intervention in preventing low birth weight is unresolved.

Two main schools of thought exist in relation to the role of antenatal care on the growth and development of the foetus. The first school of thought holds the view that antenatal care is a means to detecting high-risk pregnancies and improving foetal growth and development and is hence the determinant of an infant's birth weight (Alexander and Korenbrot 1995). The second school of thought holds the view that antenatal care could at best have a minimal impact on low birth weight, reason being that the adaptive mechanism of maternal physiology and the absolute parasitism of the foetus allow for remarkable foetal development even in the absence of good nutrition. For example Butz et al. (1993) and as such do not see poor maternal nutrition as a cause of low birth weight. This school of thought holds the view that it is poverty during mother's developmental age and pregnancy that mattered as it had a more significant effect on her reproductive efficiency.

They thus imply that a woman's socioeconomic condition during her developmental age affects her pregnancy outcomes and this works through her reproductive efficiency and anthropometry which is developed prior to her pregnancy. Also her socioeconomic condition during pregnancy affects her motivation to seek antenatal care and good nutrition which affects her pregnancy outcome. Although these studies found that mothers who received adequate antenatal care were less likely to have low weight births, the explanation provided was that the less well-to-do and uneducated were at the risk of delivering low weight babies and had less motivation to seek antenatal

care whereas the educated and well-to-do registered and sought antenatal care earlier and had lower incidence of low birth weight babies.

To this effect, previous studies have been carried out that look at the effect of maternal age, preceding birth interval, reproductive loss, maternal education, specific nutrients (Ogunjuyigbe et al. 2008), delayed bookings for antenatal care (Jinadu et al. 1983) and general antenatal care (Kramer 1987, Leveno et al. 1985, Magadi et al. 2000 & Olowonyo 2006) on low birth weight. This study shall test the validity of these two schools of thoughts and shall contribute to existing work in this field of study as I independently analyse the effect of antenatal care with and without controlling for the socioeconomic indicators to see how they affect antenatal care and what effects these have on low birth weight.

While the collective evidence regarding the efficacy of prenatal care to prevent low birth weight continues to be mixed, the literature shows that the targets that are most likely to influence low birth weights are (1) Smoking during pregnancy; (2) nutritional (aimed at low pregnancy weight and inadequate weight gain); (3) medical aimed at general morbidity and (4) System level approaches to impact the accessibility and the appropriateness of antenatal health care services to women, health promotions, social service and case management approaches may also be beneficial (Alexander and Korenbrot 1995). It may be the case that specific medical condition (such as diabetes, anaemia, hypertension-related complications and infections) may have a large individual effect on the infant's birth weight, most of these individual medical conditions does not affect a large proportion of pregnant women and may therefore contribute little or nothing to overall incidence of low birth weight. However, it is expected that strategies aimed at reducing the occurrence of infections, also will improve on birth outcomes.

Although antenatal care contributes to the identification of pregnancy complications, the early initiation of regular care has not been shown to directly reduce the incidence of low birth weight (Carey et al. 1991, Greenberg 1983, Showstack et al. 1984). However, some studies in the past (Alexander and Cornely 1987 and Gortmaker 1979) have come to a conclusion and have established a wide-spread confidence in the effect of early and frequent use of prenatal care services as a means to reduce incidence of low birth weight. Self-selection bias is a strong limitation to the interpretation of findings in this area of research (Alexander and Cornely 1987 and Gortmaker 1979). As a result of the latter and the absence of randomized controlled trials, it becomes questionable as to the effect of simply improving adequacy of prenatal care use in relation to low birth weight. This study was not meant to address the issue of self-selection bias. In the light of this, I propose that research should be geared towards addressing the self-selection bias limiting the interpretation of major findings in this area of research.

Another problem that the measurement of prenatal care has been fraught with is the prenatal care utilization indices. Indices that combine when trimester care began and frequency of visits does not address issues such as content of the care received. Kotelchuk Index for adequacy of prenatal care utilization built on the Kessner Index (Kotelchuck 1994) does well to address these issues but not withstanding, Koroukian and Rimm (2002) observed that the Kotelchuck index appears to be biased because women grouped in the intensive care category (who supposedly have more observed to expected number of visits) had the highest rates of low birth weight after having to

control for gestational age. The index is based on the ratio of observed-expected (O/E) number of visits[6].

A system level approach that will involve improving on the accessibility and appropriateness of delivery of health care services to entire groups of women with several characteristics associated with preventable risks of low birth weight may be relevant. The content of the antenatal care (captures quality of care) provided by a midwife however, which evolves through the conversation between the mother and the midwife where information on blood pressure, weight, height and general maternal morbidity and counselling about the pregnancy complication is obtained, is a very important part of antenatal care. Midwives antenatal care content includes patient education to identify signs of pregnancy complications, activity counselling in response to monitoring of the cervix by frequent examination, substance abuse counselling and nutrition counselling with emphasis on weight gain. Macdorman and Singh (1988), after controlling for social and medical risk factors discovered that the risk of having a low birth weight infant was 31% lower for a certified midwife attended birth when compared to a doctor attended birth and concludes that certified midwife births had excellent birth outcomes.

Also, early trimester and regular antenatal care visit have been associated with a reduced incidence of low birth weight and prematurity. Letamo and Majelantle (2001), finds this relationship showing that late timing and less frequent attendance of antenatal care and women who have had a pregnancy terminated before were at the risk of giving birth to low birth weight infants and concludes that improving a nation's low birth weight rates will require more than simply improving the content of prenatal care and changing risk factors for individuals but also encouraging early antenatal care visit.

3.2 Maternal morbidity and quality of antenatal care

The maternal environment is the most important determinant of birth weight and factors such as maternal under-nutrition, malaria, anaemia, STDs that prevent normal circulation across the placenta cause shortage of nutrient and oxygen supply to the foetus and restricts the growth of the foetus. Maternal tetanus infection is expected to increase the risk factor for low birth weight and it induces malnutrition by interrupting food intake via anorexia. Tomkins et al. (1994) did show that maternal infection which reflects maternal morbidity status and quality of antenatal care affects fetal growth via: (1) Disruption in maternal nutrition which in turn makes supply of nutrients less available to the foetus; (2) Inability of the placenta to transfer nutrients satisfactorily as a result of several disease conditions and a reduction in blood flows And (3) Foetal infection which causes impaired growth and development.

[6] The expected number of visits is based on the American College of Obstetricians and Gynaecologists (ACOG) recommendations. It also considers the month of initiation of prenatal care. The apparent bias results from the fact that ACOG schedule of prenatal visits accords nearly 1/3 of visits to the last 4-5 weeks of gestation. Shorter gestational days imply fewer numbers of expected visits, a smaller denominator in the O/E ratio and (O/E) ratios exceeding 100% by large margins. They find that the observed number of visits exceeds the expected number of visits by only 1 or 2 in 4.1% of all births grouped in the Adequate+ category. The index yields misleading results, concluding that women in the adequate+ category (or O/E) ratio>110% are most likely to deliver low birth weight babies but having controlled for gestational age, they find a contrary result of adequate+ care less likely to have low birth weight infants.

Tetanus toxoid injection captures maternal morbidity status during pregnancy and quality of antenatal care. It is a combination of immunizing agent that prevents diphtheria and tetanus infections in women. Immunizing women of childbearing age with at least three doses of tetanus toxoid injection protects them against maternal and neonatal tetanus infection because a mother passes her immunity to her unborn child when she is immunized. The World Health Organization and the Nigerian government (FMH 2000) have made progress with the introduction of the Expanded Program on Immunization (EPI) as it was formerly known, but now known as National Program on Immunizations (NPI) with the sole focus of immunizing all infants and mothers in Nigeria (MMWR 1999). Toxoids currently used often in Nigeria include diptheria, tetanus, capsular polysaccharides of pneumococci, meningococci and hemophilus influenzae and the surface antigen of hepatitis B virus (UNICEF 2000). Even though several countries adopted the WHO recommended 5-dose tetanus toxoid vaccination schedule, reported tetanus toxoid vaccination schedules with at least 2-doses among pregnant women increased rose from 7%-39% in between 1980 and 1996.[7] Although Owa and Makinde (1992) found that 74.6% of 896 mothers of babies 0-12 months interviewed in a local government in south western part of Nigeria in 1992 claimed they received tetanus toxoid injections, UNICEF (2000) progress reports shows that Nigeria ranks second largest for tetanus infection and this did account for a 34,600 neonatal tetanus deaths in 1999.

UNICEF Country Status Reports in 2000 have shown that Nigeria is among the class C countries in terms of maternal tetanus elimination and tetanus toxoid immunization coverage.[8] Several foetal infections transmitted across the placenta are associated with decreased birth weight and high–risk medical care in general may have a higher impact on reducing the incidence of low birth weight than individual-specific interventions but not all of the former may reduce the chances of low birth weight. Strategies that eliminate the incidence of tetanus infections such as Tetanus toxoid vaccines is expected to reduce the incidence of low birth weight and ensure better pregnancy outcomes.

Pregnancy complications are an important source of poor pregnancy outcomes and information about pregnancy complications and guidance on where to go when they arise (proxy for the quality of antenatal care), is an important determinant of pregnancy outcomes; thus should be routinely included in all antenatal care services. It is expected that women who get such information are likely to obtain the required care when complications arise in order to ameliorate any form of poor pregnancy outcome. It thus serves as a precautionary measure for birth outcomes.

3.3 Maternal nutrition

Low maternal weight for height and low birth weight reflect inadequate food intake in women. In developed countries, (Kelly and Pojda 2000) in Kramer

[7] AFRO/VPD Data Tables. August 2000

[8] These countries are far from maternal and neonatal tetanus elimination. In each of these 17 class C countries, more than 50% of the districts are at high risk of maternal tetanus. The health infrastructures in these countries are limited as indicated by routine DPT3 immunization coverage. These countries may need 3 to 4 years to phase in elimination activities. Because maternal tetanus has not been defined, the elimination of neonatal tetanus is used as a proxy for maternal tetanus elimination.

(1987), low birth weights are associated with factors such as pre-eclampsia and cigarette smoking, while alcohol and the use of drugs may also restrict the growth of the foetus. Kramer (1998) later adds that secular increases in pre-pregnancy Body Mass Index (BMI), gestational weight gain and reduction in maternal smoking are responsible for normal birth weights and the modest decline in low birth weight and that maternal anthropometry has little or no impact on gestation duration. Poor maternal nutritional status at conception, short maternal stature due to mother's own childhood under-nutrition and/or infection and low weight gain during gestation as a result of inadequate dietary intake have been identified as determinants of low birth weight in developing countries (Achadi et al. 1995, Anderson & Bergstrom 1997, Effiong 1979, Hussain & Omololu 1983, Kramer 1998, Sharma et al. 1994).

Pregnant women need to increase food intake by at least 200 calories or even more if their pre-pregnancy weights were low. They need to gain at least 1kg per month during their second and third trimesters. As a result of the fear that eating too much may result in having big babies which may in turn make delivery difficult, these women may accept more nutritional education that focus on eating specific foods than just eating more food. The main objective of food supplements during pregnancy is not to promote fetal overgrowth but to prevent low birth weight. It has been shown that increases in head circumference of an infant due to food supplements taken by the mother have not been too large (about 1-3mm) as to cause cephalo-pelvic disproportion which may lead to obstructed labour but evidence exists that food supplements actually reduce perinatal mortality (Ceesay et al. 1997). Women who do not gain approximately 1kg/month or women who lose weight between consecutive visits endanger both themselves and the foetus.

Although gaining a 1kg/month for pregnant women is attainable, most women in developing countries still do not gain this recommended amount of weight because many of them practice *eating down* (eating less) during pregnancy for fear of the possibility of cephalo-pelvic disproportion. To them, a small-sized baby is not considered a problem. Rajan and Oakley (1990) in their study of women's view of the risk of low birth weight found that 37% of these women did not see any problem with low birth weight. They respond that smaller babies are easier in labour and delivery.

Another explanation that may be driving poor maternal nutrition which is positively associated with the high incidence of low birth weight in Nigeria is the restrictions placed on some foods where in effect these prohibited foods are common sources of essential nutrients for pregnant women (Ogunjuyigbe 2008).

In Kenya, Magadi et al. (2000), using the Kenya 1993 DHS analyses individual and community level factors associated with premature births, size of baby at birth and caesarean section using a multilevel logistic model and shows that maternal nutritional status (such as weight for height score and maternal height) is a predominant factor in determining size of baby at birth. Ozumba and Okafor's (2003) study of low birth weight in Eastern Nigeria finds also that maternal antenatal complications such as; ante partum haemorrhage, malaria, multiple pregnancy, pregnancy-induced hypertension and anaemia known to predispose to low birth weight babies are common in Nigerian obstetric practices. Multiple pregnancies were highly significant and positively associated with low birth weight may be as a result of the high incidence of multiple births in this part of Nigeria.

Anderson and Bergstom (1997), who understudied chronically malnourished African central African women and Ebimoyi et al. (1991) in the case of Nigeria individually finds that heavier mothers and mothers who gain weight during pregnancy are likely to have heavier infants. Some nutritionists, policy makers and prenatal care providers would argue that it is the quality and not the quantity of nutrients that matter for birth weight gain. It is hence argued that pregnant women who eat calorically-dense 'junk food' may gain adequate weight which could be detrimental for pregnancy outcomes. However in women, who take adequate energy nutrients, protein is rarely a limiting nutrient and high protein diet may also have adverse effects. Increased pre-pregnancy and gestational weight gain is not without a cost as Kramer (1998) show that pre-pregnancy obesity is strongly associated with late fetal death (stillbirth) and excessive weight gain increases the risk of fetal macrosomia, caesarean section and maternal weight retention. In the large sense of it, the available research on this issue suggests that benefits may be largely attributed to women who are undernourished.

3.4 Maternal smoking and low birth weight

Smoking has been confirmed a high risk factor for low birth weight. Studies have shown that cessation of smoking by expectant mothers has significant effect on increasing birth weight in most intervention trials (Herbel et al. 1988, Sexton and Herbel 1984). Methods applied to bring about smoking cessation include; self-help methods, health education and counselling programmes. However, Kramer (1987) has shown that maternal smoking is not a cause of low birth weight in developing countries.

3.5 Socio-economic indicators and demographic risk factors on low birth weight

Women of low economic status have been associated with a high-risk of having low weight babies (Brown 1985). Tuntiseranee et al. (1999) examined the effect of socioeconomic determinants of pregnancy outcomes for Thailand to find that mean birth weight correlated with family income even after adjusting for maternal characteristics and number of antenatal visits. In his view, socioeconomic status of the household is a major determinant of the weight of a baby at birth. The possibility that the association observed between adequate prenatal care utilization and lower incidence of low birth weights, may in part, reflect woman who decide to use prenatal care in the first trimesters and frequently (Butz et al. 1993).

Although some studies are inconclusive regarding the role of maternal education on pregnancy outcomes, it is expected that education and occupation impact negatively on poor pregnancy outcomes (Ebimoyi et al. 1991, Karim and Mascie-Taylor 1997, Tuntiseranee et al. 1999) as a result of their ability to improve women's status and access to information. On the contrary, some studies have found that the more educated a woman is, the more her likelihood of experiencing poor birth outcomes. A possible explanation for this is the finding from the study on Nigeria, Adetunji (1995) suggesting that unemployment rate was high among secondary school

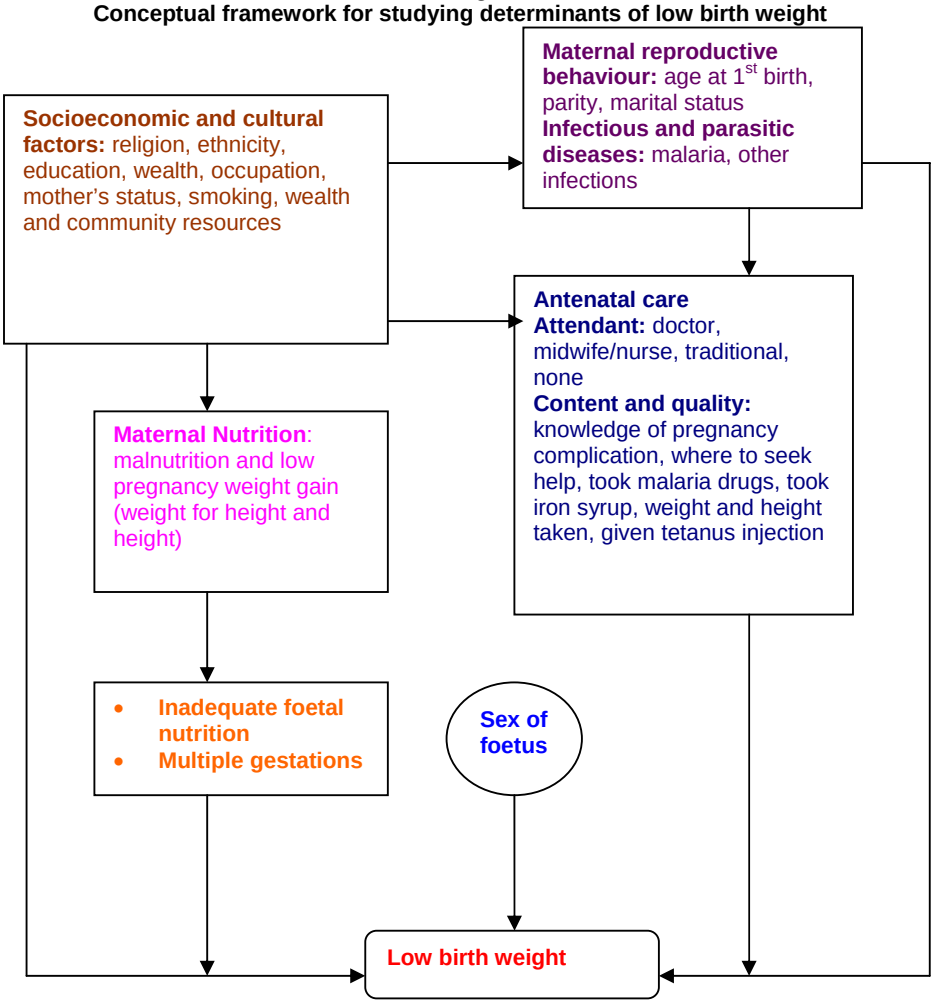
graduates which impacted their socioeconomic status, thus reducing access to health care and Prazuck (1993) on Burkina Faso, suggested that educated mothers were more likely to use motorbikes also known as 'okada' on bumpy roads which caused intra-uterine vibrations, resulting in poor birth outcomes.

From an individual point of view, demographic risk factors tend to impact birth weight smaller than would medical condition effects. These risk factors affect larger numbers of women and altering it is quite difficult. However, the higher incidence of very low birth weight among teenage mothers may be an indication that some demographic risk factors are partly amendable by population-based comprehensive and prenatal interventions.

There is a fairly consistent relationship between some of the demographic risk factors such as sex, age, parity and birth intervals and low birth weight. Several authors Magadi et al. (2000) have found birth order as an important factor influencing birth weight and first order births are on average more likely to be small babies than higher order births. Although it is expected that short birth intervals will increase the risk of adverse outcomes, some studies (Voorhoeve et al. 1984) have showed a reverse relationship. Ebimoyi et al. (1991) and Olowonyo et al. (2006), found that in Nigeria, low birth weight was common with some ethnic groups, female infants, teenage and educationally disadvantaged mothers. In the same light, Ozumba and Okafor (2004), for Eastern Nigeria have shown that complications that arise during pregnancy such as haemorrhage affect low birth weight.

Like other human development indicators, low birth weight tends to regenerate into a poor health trap for the child, not just as an infant but also as an adult because of the inter-generational effect. Akesode et al. (1994) have shown this effect in their study of perinatal mortality in Nigeria where they find that low birth weight is one of the major causes of early neonatal death. They emphasised the need for increased utilization, improvement, and regionalization of antenatal and perinatal care services. Based on the previewed literature, prenatal care, socioeconomic and demographic indicators are likely to influence low birth weight as shown in the conceptual framework presented in figure 3.

Figure 3
Conceptual framework for studying determinants of low birth weight



***Source*: Author (November 2008)**

Chapter 4

DATA AND METHODS

4.1 Analytical Framework

This study basically will seek to find the following; the role of prenatal care on low birth weight while controlling for socioeconomic indicators of women using the 2003 NDHS survey. Data from the mother's recall from children's questionnaires of the 2003 Nigerian Demographic and Health Survey (NDHS) is used. Information on household socio-economic status, women's characteristics and births occurring five years preceding the survey were provided in the questionnaire. A total of 5,601 women who had births in the five years preceding the survey were eligible out of which approximately one-third live in urban areas and two-thirds of these women live in rural regions. However I have carried out my analysis based on the 3,397 of these women that had complete information on the variables I have used in the analysis.

Excluding cases with missing information from the analysis is unlikely to bias the results since, having examined the sample with all cases and without cases with missing data, I found that the proportions (characteristics) of women included in the analysis and those not included are fairly similar (within ±0.2 standard deviation)[9] and the proportion of the outcome variable in the two samples were fairly similar (within ±0.2 standard deviation). However, a failure to demonstrate a substantial similarity in the selection effect for women with missing and complete information for antenatal care and Muslim religion variables (owing to the tendency that Muslim women do not provide information because of Shariah restrictions although they are least likely to use antenatal care), may imply that the sample may not be well representative of the country, not withstanding, it is more representative than studies that rely on hospital data in Nigeria. This may be as a result of the differences in the distribution of some key variables in both samples. To the effect that this is a plausible expectation, this study systematically underestimates the effect of antenatal care.

The NDHS of 2003 used a multi-stage cluster sampling procedure. Macro International 2003 describes the sampling procedure (provided in the final report section in the Nigerian Demographic and Health Survey 2003).

4.2 Definition of variables

Several studies addressing the factors associated with poor pregnancy outcomes have used low birth weight as the outcome variable and most of these studies have been based almost exclusively on hospital data (Effiong 1979, Mbazor & Umeora 2007, Oladipo & Osiberu 2008, Ozumba & Okafor 2006). This approach is prone to limitations; instead, population-based studies (that use DHS survey data) which include women who use modern as well as other (traditional) maternal health care are representative and are expected to identify better, factors responsible for low birth weight. I have used

[9] See Appendix A1

information on mothers' reporting of the size of their babies at birth as my outcome variable and as a proxy for birth weight information.

4.2.1 Preliminary analysis on the reliability of mother's reporting of birth size

The analysis presented in this paper is based on mothers' report for the outcome variable: small size of baby at birth. Amiss the representativeness of the 2003 DHS survey, birth weight information for the majority of births in Nigeria are not available because 85% of the births were not weighed (WHO & UNICEF 2004); hence I have used 'size of baby at birth' as my outcome variable. This mothers' reporting for size at birth may be unreliable and the measurement error is likely to be critical since it is subject to personal perceptions and possible systematic errors. Thus the preliminary analysis involves an assessment of the reliability of reported 'size of baby at birth'. The birth sizes are reported as 'very large', 'large than average', 'average', 'smaller than average' and 'very small'. 'Smaller than average' and 'very small' were grouped together as small size at birth and 'average, larger than average and very large were used also grouped together as large birth size. These two groups formed my outcome variable for size at birth. I generated a binary response variable Y for the occurrence of size at birth as;

Y= 1: Child has small size at birth (smaller than average & very small)
0: Child has large size at birth (average, larger than average & very large: reference category)

The term 'average' compares to the 2500g threshold used in birth-weight measurements. Overall, 14.8 percent of the 5,601 births within the five years preceding the survey were reported to be very small or smaller than average; it is in consonance with UNICEF's estimate of 14% of low birth weight in the same period under consideration in Nigeria. In Table 3, I have examined the distribution of information on 'size of baby at birth' against 'birth weight' information, for cases where such information were available, so as to assess the reliability[10] of 'size of baby at birth' information used in this study and find that the latter is reliable.

Table 3
The distribution of reported size of baby at birth by birth weight

Reported size of	Birth weight (grams) (95% Confidence Interval for mean)		
Baby at Birth	Median	Lower bound	Upper bound
Very Small	1121	1000	1200
Smaller than Average	2189	1800	2450
Average	2993	2500	3500
Larger than Average	3907	3600	4450
Very Large	4800	4500	6000
Total no. of observations	**5601**		

[10] Reliability here implies that I compared the information on mother's recall of the baby's size and the available birth weight information so as to see if birth size could be used as a proxy for birth weight in the absence of birth weight information.

Source: Author from NDHS 2003

The distribution of the size of baby at birth information by the median birth weights or the 95% confidence interval for mean conform to the expectation and suggests that the mother's reporting of size of baby at birth is fairly reliable and generally agrees with recorded birth weight information. This would be based however on the assumption that mothers whose babies were not weighed assessed their babies on a similar scale to those whose babies were weighed and those whose babies were weighed assessed the sizes of their babies independently of the baby weights. However, it is not entirely ruled out that weights recalled from memory may be heaped at 2500g.

Previous studies have addressed the reliability of mothers' reporting on size at birth and find them to be reliable. Although Eggleston et al. (2000) conclude that maternal assessment of birth size is a poor indicator of birth weight, Magadi et al. (2000) assessed the issue of the reliability of mothers' reporting of size at birth against the available birth weight information using 1993 Kenya DHS and found it to be reliable. Also, DaVanzo et al. (1984) showed evidence from the Malaysian Family Life Survey that mothers' recall of birth weight, including that of 'unweighted babies' are approximately same as the reported size at birth, and can be used to examine biological and socioeconomic determinants of birth weight. Boerma et al. (1996) noted in his study that sensitivity of the relative size at birth as a predictor of low birth weight improved to a mean of 66% when using infants reported to be either very small or small than average than when only infants reported only to be very small are used.

The rest of the data was later subjected to a multivariate logistic analysis where socio-economic variables and demographic risk factors were added to the prenatal care variables in a bid to identify important determining factors of birth size in Nigeria. The analysis was divided into the type of place of residence (rural and urban areas) because from the 2003 NDHS survey, several health outcomes varied largely between the two broad places of residence and each of these logistic regressions was subjected to women that had single births (twins/multiple births were excluded because we cannot isolate the effect of pre-natal care on each of the babies that were multiple birth outcomes). A logistic distribution function lends itself to a biologically meaningful interpretation (Homer and Lemeshow 1989). This works for a binary outcome variable such as size at birth (small or large) as shown in the model below;

$$\text{Log}_e p/(1-p) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_k X_k + \varepsilon i$$

p is the probability of a live child being born small, given the independent variables X_1 to X_k. The dependent variable is coded 1 if the child is born small (<2500g) in the model and zero otherwise. This type of model allows for the estimation of the probability of an event occurring for a group of dependent variables and is applied also in the calculation of the relative risk of experiencing an event (Kiernan and Diamond 1983).

4.2.2 Independent variables

Defining the most accurate way to measure the adequacy of antenatal care has been a major challenge. Over time, researchers (Alexander and Korenbrot 1995) have defined it as the frequency/number of visits, the pregnancy stage at which care begun, place and type of care provider, care content (weights and height measured, if malaria and tetanus injections were given, blood tests) etc. For example, using the trimester she began her care as a measure may well be confounded by gestational age (Shwartz 1962). The need for adjusting for the effects of gestational age in studies relating prenatal care use to birth weight has been recognised by many researchers. It was not possible to adjust for this in our analysis because we do not have information on the gestational ages at which trimester care began for all the births in the five years preceding the survey. Kotelchuck (1994) also proposed using the Kotelchuck Index, this however has been shown to have shortcomings (Koroukian & Rimm 2001).

Being that prenatal care indicators are my variables of interest, I included them individually in my final model as the correlation between them was not such that could affect the precision of my results. I did not use an index because of the difficulty in interpreting such index. The prenatal care variables in my model are; antenatal care provider (doctor, midwife/nurse, traditional and no one); Quality and content of antenatal care (if the woman took tetanus injection during pregnancy, if the woman was told of pregnancy complications and where to go in case of pregnancy complications and if she took malaria tablets during pregnancy) and the time she began her antenatal care visit. Tetanus injections also capture the maternal morbidity status.

The maternal nutritional position is captured by her weight for height score and height. The overall economic position of the mother is captured by the household wealth status. Other mothers' characteristics include her age at birth, preceding birth interval, educational attainment, family planning method, smoking habit, and status in decision-making, religion and region of residence. Children's characteristics are sex of the foetus and birth order. Other variables included in the model include household characteristics (availability of public tap and flush toilet).

Most of the prenatal care and other independent variables used in this study relied on mothers' recall, which may have introduced some measurement error because it is based on personal perceptions. Therefore, the possibility of recall bias must be considered in the interpretation of these results.

A major concern in the analysis is the fact that the determinants of small size at birth may operate at many levels such as mother, households, cluster or even district levels (hierarchical data structure). The individual observations in this data structure are not completely independent and the results of the analysis may be affected by the clustered nature of the data, thus one faces the problem of heteroscedasticity. For instance, the accessibility of health facilities and personnel within a cluster could contribute to small size at birth and the effect of such factors may vary at the individual mother and community levels. Hence, the use of a multilevel statistical technique (which takes the hierarchical data structure into consideration) may be appropriate for this study. However adoption of the latter technique is not possible considering the limited time for this study. For the purpose of this study, I controlled for the variables at different levels and obtained robust standard errors (corrects for heteroscedasticity) which relaxes the assumptions that the observations are independent and constant error variance was obtained.

Chapter 5

RESULTS: FACTORS ASSOCIATED WITH SIZE OF BABY AT BIRTH

5.1 Descriptive analysis

Table 4 provides information on the percentage of women that gave birth to small babies by regions, i.e. the six geopolitical zones in Nigeria[11].

Table 4
Incidence of small size at birth (%) by regions in Nigeria

Incidence of low birth weight by region

Region	Small size at birth
North central	158 (16%)
North east	254 (18%)
North west	210 (12%)
South east	61 (14%)
South-south	71 (14%)
South west	69 (12%)
Total	823 (14%)

Note: Birth weight information is based on mother's recall and incidence is defined in terms of percentage of women who reported to have given birth to small babies.
Source: NDHS 2003

The incidence of small size at birth is higher in the north compared to the southern part of the country. Eighteen percent (254 women) of the total women sampled in the north east in the survey gave birth to small babies. In the south, 12% of the women in the south west who were sampled reported to have given birth to small babies; whereas 14% of women in each of south east and south-south reported to have given birth to small babies. In total, the incidence of low birth weight in the country lies around 14% which is high compared to other developing and developed countries. The possibility that mother's recall may be biased is not totally ruled out as it is subject to personal perception and possible systematic errors. However, the precision of the result shown in Table 4 may not be affected if it is viewed in the backdrop of Table 3 which presents an assessment of the reliability of the reported size at birth. I present the descriptive statistics for the independent variables in Table 5.

[11] See appendix A.3 for a map of Nigeria showing the six geo-political zones.

Table 5
Descriptive statistics of selected variables from 2003 NDHS

Variable	Mean	Std. Dev.
Antenatal care (doctor)	0.21	0.41
Antenatal care (midwife/nurse)	0.51	0.50
Antenatal care (traditional)	0.03	0.18
Antenatal care (None)	0.34	0.47
Tetanus injection=1	0.34	0.47
Time antenatal care visit began	4.65	1.64
Told where to go for complications=1	0.22	0.41
Told of pregnancy complications=1	0.23	0.42
Took malaria drug during pregnancy=1	0.25	0.43
days took iron syrup during pregnancy(<100)	0.60	0.49
>100	0.30	0.46
Do not know	0.10	0.30
Weight for height (WHO ref. median)	117.35	21.53
Height (cm)	158.31	6.12
Smokes=1	0.01	0.09
family planning (no method)	0.85	0.35
family planning (folkloric method)	0.01	0.12
family planning (traditional method)	0.03	0.18
family planning (modern method)	0.10	0.30
Single birth=1	0.96	0.20
Preceding birth interval (months)	36.21	20.98
Birth order	4.06	2.72
Maternal age at first birth	18.54	3.92
Female=1	0.49	0.50
Flush toilet in house=1	0.10	0.30
Water facility in house	0.09	0.28
Wealth index	2.84	1.40
Mother's educational attainment	1.30	1.56
Mother's status	0.22	0.42
Catholic	0.10	0.31
Protestant	0.13	0.34
Other Christians	0.14	0.34
Muslim	0.61	0.49
Traditional	0.02	0.13
Urban	0.35	0.48

Note: The number of observations ranges from 2095 to 5591

Main features of these data are discussed below. Antenatal care content variables which captures quality of antenatal care show about one-third of the women in the sample had one or more tetanus injection during pregnancy and 18% of these women were told of pregnancy complications but only about 15% of them were provided guidance on where to go in case they had pregnancy complications. 22% took malaria drugs during pregnancy. The average number of women attended to by a doctor during antenatal is 20% and for midwives is 44%. 42% of the women were not attended to by any one for antenatal care. The average weight for height score[12] is 114 and the average height is 158cm. On average, the women in the sample come from middle income households and most households tend to maintain four children per couple, about 93% of the births are single births and about half of them are females. In both urban and rural areas, only 1% of the women smoke. These results can be viewed in the backdrop of section 2.1, which describes the health outcomes in Nigeria.

[12] Weight for height percent of reference median is based on World Health Organization (WHO) reference standard. The weight of an adult is very dependent on her height. This index has been adjusted for pregnant women according to duration of pregnancy.

5.2 Association between size of baby at birth and selected characteristics

The bivariate relationship between size of baby at birth and some independent variables is presented in Table 6.

Table 6
Bivariate analysis for birth size and selected variables

	Urban			Rural		
	Birth size and selected variables			Birth size and selected variables		
Variable	Birth size=0	Birth size=1	p-Value	Birth size=0	Birth size=1	p-Value
Antenatal care (doctor)	0.37	0.34	0.448	0.13	0.13	0.794
Antenatal care (midwife/nurse)	0.66	0.61	0.215	0.44	0.35	0.002
Antenatal care (traditional)	0.02	0.03	0.520	0.04	0.02	0.121
Antenatal care (None)	0.15	0.20	0.093	0.43	0.54	0.000
Tetanus injection	0.48	0.46	0.728	0.28	0.22	0.004
Trimester visit began	4.54	4.59	0.718	4.76	4.67	0.543
Told of pregnancy complications	0.67	0.57	0.085	0.19	0.13	0.004
took malaria drug during pregnancy	0.35	0.36	0.670	0.20	0.17	0.108
days took iron syrup during pregnancy	170.71	167.65	0.907	167.59	140.08	0.295
Told where to go for complications	0.95	1.11	0.004	0.18	0.12	0.002
Weight for height (WHO ref.)	122.58	117.82	0.006	115.24	111.57	0.000
Height (cm)	159.71	158.36	0.002	157.62	157.29	0.237
Smokes	0.01	0.01	0.569	0.01	0.01	0.813
family planning (no method)	0.78	0.83	0.093	0.89	0.91	0.115
family planning (folkloric method)	0.01	0.00	0.731	0.02	0.01	0.157
family planning (traditional method)	0.06	0.06	0.967	0.02	0.02	0.736
family planning (modern method)	0.16	0.11	0.067	0.07	0.06	0.325
Wealth index	3.91	3.56	0.000	2.32	2.08	0.000
Mother's educational attainment	1.95	1.63	0.006	1.00	0.81	0.002
Flush toilet in house	0.23	0.14	0.003	0.04	0.04	0.687
Water facility in house	0.18	0.16	0.607	0.04	0.05	0.128
Maternal age at first birth	19.39	19.15	0.426	18.15	17.96	0.272
Birth order	3.74	3.92	0.338	4.08	4.17	0.518
Preceding birth interval (months)	37.70	37.47	0.897	35.19	34.11	0.298
Husband lives at home	0.90	0.90	0.896	0.93	0.92	0.409
Last child wanted	1.24	1.29	0.154	1.19	1.23	0.114
Terminated pregnancy before	0.20	0.20	0.885	0.15	0.17	0.138
Single birth	0.06	0.11	0.009	0.05	0.09	0.008
Female	0.48	0.59	0.002	0.49	0.54	0.037
Mother's status	0.28	0.24	0.175	0.20	0.15	0.008
north central	0.16	0.22	0.018	0.18	0.18	0.982
north east	0.24	0.31	0.030	0.23	0.32	0.000
north west	0.23	0.16	0.017	0.36	0.31	0.017
south east	0.10	0.11	0.622	0.06	0.06	0.980
south-south	0.08	0.09	0.979	0.10	0.09	0.339
south west	0.19	0.12	0.011	0.07	0.05	0.124
Catholic	0.11	0.12	0.593	0.11	0.07	0.022
Protestant	0.11	0.12	0.633	0.15	0.09	0.001
Other Christian	0.16	0.11	0.037	0.13	0.14	0.494
Muslim	0.60	0.63	0.465	0.60	0.67	0.001
Traditionalist	0.01	0.02	0.539	0.02	0.02	0.283

Notes: The last column of the table reports the p-value for a two-tail t-test. The null hypothesis is equality of means. In the urban area, the number of observations with birth size=1 ranges from 167 to 255 and the number of observations with birth size=0 ranges from 893 to 1849. In the rural area, the number of observations with birth size=1 ranges from 338 to 564 and the number of observations with birth size=0 ranges from 1051 to 3064.

In the urban areas, the mean midwife-attended antenatal care for mothers with small sized babies is 61% compared to 66% for mothers who gave birth to bigger babies. In the rural areas, the incidence of small size at birth is higher among mothers with mean midwife care attendance of 35% and

lower among mothers with mean midwife care attendance of 44%. Average tetanus injection taken varies significantly among women whose babies are small at birth and those whose babies were not especially in rural areas. It is 28% and 22% for women whose babies' sizes are normal and those whose babies are small respectively. Mothers who received tetanus injections during pregnancy are more likely to have bigger babies. The timing in which antenatal care visit began does not seem to have any bearing on size at birth. In the rural areas, the incidence of small size at birth is lower among women who were told of pregnancy complications and where to go for it. Average weight for height score among women in urban areas who had small infants is about 117 compared to 122 for those whose babies' sizes are normal. In the rural areas, average weight for height score is 115 for mothers whose babies' sizes are normal and 111 for those who had small sized babies.

The mother's smoking habit has no bearing on the size of baby at birth in both rural and urban areas as only 1% each of the women in rural and urban areas smoke. This confirms studies that find that maternal smoking is not a determinant of low birth weight for developing countries. The incidence of small size at birth is lower in economically better off households, this is expected since mothers from poorer households are expected to seek antenatal care late or may not seek it at all. While maternal age at birth does not have any bearing on birth size, female infants are more likely to be born small and there is a difference in the mean amount of single births across the two categories, a finding also reported in NDHS 2003. On average, in the urban areas, women in the south west region have the lowest incidence of small size at birth. In the rural area, north east on average has the highest incidence of small size at birth.

5.3 Multivariate logistic regression estimates

My choice of variables in the logistic regression was based on findings (Ebimoyi et al. 1991, Alexander and Korenbrot 1995, Kramer 1998, Magadi et al. 2000) on low birth weight and the bivariate analysis in Table 6. Logistic regression is fitted with birth size as the outcome variable. This was related to independent variables in four different specifications.

Specification 4 forms the final model[13]. The description of the results was based on prenatal care variables and some selected variables which I considered crucial regardless of their significance level. Following the narratives so far, my discussion focuses on the role of prenatal care, controlling for maternal nutrition, socioeconomic and demographic factors on small size of baby at birth.

[13]In the course of the analysis, I obtained a prenatal care utilization index based on the Kotelchuck index and carried out a bivariate and multivariate analysis and found their Chi-square to be significant but having controlled for other variables in the multivariate analysis, they dropped the sample size to 737 observations. Women whose prenatal care utilization was 'adequate plus' had reduced odds of giving birth to small-sized babies compared to those in the 'inadequate' category. The results did conform to Kotelchuck (1994) and Alexander and Korenbrot (1995) however, they were not significant. I also controlled for women who took iron syrup but found no significant results for these variables. I have presented this in Table A.2 in the appendix.

5.3.1 Factors associated with the size of a baby at birth in urban and rural areas

This study has a number of strengths compared with previous studies of the role of prenatal care on low birth weight; it is a population-based that uses a recent DHS survey data 2003 which includes information on women who use modern as well as other (traditional) maternal health care which is more representative and are expected to identify better factors associated with small size at birth than previous studies that relied on hospital data.

Analysis was carried out uniquely for urban and rural areas. In the urban areas (Table 7), the significant factors associated with small size at birth are tetanus injections, women who were told of pregnancy complications, maternal height, and female foetus, availability of flush toilet, region of residence and socioeconomic status of mother.

Table 7
Odds ratio for small size at birth by antenatal care, socioeconomic and demographic indicators for women who delivered live-birth singletons in urban areas five years preceding the 2003 DHS

	Specification 1		Specification 2		Specification 3		Specification 4	
Variable	Odds Ratio	p-Value	Odds Ratio	p-Value	Odds Ratio	p-Value	Odds Ratio	p-Value
antenatal (doctor)	1.04	0.865	1.07	0.785	1.09	0.715	1.06	0.797
antenatal (midwife)	1.04	0.865	0.98	0.937	0.97	0.909	0.96	0.872
antenatal (traditional)	1.22	0.717	1.36	0.590	1.42	0.545	1.57	0.446
antenatal (None)	0.80	0.593	0.67	0.358	0.66	0.349	0.66	0.358
took no tetanus injection*								
Tetanus injection	0.78	0.002	0.78	0.002	0.78	0.002	0.78	0.002
antenatal visit began at 1-3 months*								
4-6 months	0.70	0.106	0.72	0.138	0.71	0.131	0.74	0.197
7-9 months	0.85	0.599	0.85	0.624	0.86	0.632	0.89	0.712
Pregnancy complications (not told where to go)*								
told where to go	0.50	0.101	0.53	0.148	0.51	0.137	0.47	0.097
Not told of pregnancy complications*								
told of complications	1.52	0.330	1.57	0.316	1.64	0.272	1.85	0.183
Took no malaria drug*								
took malaria drug	1.01	0.970	1.03	0.886	1.02	0.896	1.06	0.740
Weight for height (100-120: WHO ref.)*								
weight for height (<100)					1.22	0.405	1.20	0.460
weight for height (>120)					0.90	0.607	0.90	0.618
height (150-160 cm)*								
height (<150)					1.55	0.231	1.64	0.179
height (>160)					0.72	0.083	0.72	0.075
No smoking*								
smokes1					2.61	0.276	2.27	0.355
No family planning*								
family planning (folkloric)							0.98	0.986
family planning (traditional)							1.42	0.338
family planning (modern)							1.02	0.940
preceding birth interval (2-3 years)*								
< 2 years							1.12	0.684
more than 3years							1.04	0.878
Higher order births*								
first birth							1.12	0.646
age at first birth (15-19 yrs)								
below 15 yrs							1.00	0.988
20 yrs and above							1.40	0.210
Male*								
Female							1.64	0.006
No flush toilet*								

flush toilet		0.59	0.061	0.62	0.091	0.60	0.078
No public tap*							
public tap		0.86	0.521	0.86	0.530	0.88	0.596
South west*							
north central		2.23	0.017	2.27	0.016	2.41	0.010
north east		1.62	0.177	1.60	0.187	1.77	0.121
north west		1.17	0.671	1.17	0.669	1.30	0.484
South-east		1.42	0.433	1.39	0.465	1.32	0.532
south-south		2.19	0.051	2.18	0.053	2.18	0.056
Poorest*							
Richest		0.86	0.720	0.85	0.706	0.72	0.461
Richer		0.57	0.152	0.57	0.156	0.49	0.081
Middle		0.67	0.321	0.63	0.248	0.52	0.117
Poorer		1.33	0.489	1.28	0.550	1.21	0.649
No education/incomplete primary*							
complete primary		1.13	0.662	1.14	0.652	1.15	0.628
Incomplete secondary		1.17	0.571	1.22	0.473	1.24	0.446
complete secondary		1.06	0.860	1.13	0.702	1.06	0.872
higher		1.21	0.657	1.26	0.592	1.11	0.825
Does not take part in decision making*							
takes part		0.82	0.351	0.82	0.353	0.82	0.383
Catholic*							
Protestant		1.10	0.792	1.10	0.782	1.03	0.924
other Christian		0.73	0.397	0.72	0.380	0.66	0.279
Islam		0.95	0.890	0.90	0.769	0.85	0.651
Traditionalist		0.89	0.885	0.74	0.719	0.61	0.570
Observations	1215.00	1213.00		1213.00		1213.00	
Pseudo-R2	0.02	0.05		0.06		0.07	
Prob>chi2	0.02	0.02		0.01		0.01	

Note: the t-statistics are based on robust standard errors. P-value is significant at least at 10% level. * Reference categories.

a. Specification 1: prenatal care variables alone
b. Specification 2: specification 1 and socio-economic indicators
c. Specification 3: specification 2 and maternal nutrition variables
d. Specification 4: specification 3 and demographic variables. Specification 4 is the final model

Significant results associated with the size of a baby at birth, for rural areas, shown below in table 8 include: tetanus injections, women who were told of pregnancy complications, timing of antenatal care visit, maternal weight for height, maternal height, and sex of foetus, availability of public tap, region of residence and socioeconomic status of mother, mothers' education, decision-making status of mother and mothers' religion.

Tetanus toxoid injections

Among the estimates of prenatal care variables, quality of antenatal care and maternal morbidity status (measured by tetanus injection) is observed to be important in predicting size of a baby at birth. This suggests that babies in urban and rural areas whose mothers had at least one tetanus injection during pregnancy show a 22% and 10% decrease in the probability of being born small respectively compared to babies whose mothers were not given the injection. It has direct causal impact on the incidence of small size at birth and remained significant and their magnitudes (table 8, specification 1-4) did not change across all four specifications. The smaller effect of tetanus injections may have been due to the restrictions to speak observed among the Muslim women in the survey. Studies such as Tomkins (1994) have shown that maternal infection is a strong determinant of birth weight.

Table 8
Odds ratio for small size at birth by antenatal care, socioeconomic and demographic indicators for women who delivered live-birth singletons in rural areas five years preceding the 2003 DHS

Variable	Specification 1 Odds Ratio	p-Value	Specification 2 Odds Ratio	p-Value	Specification 3 Odds Ratio	p-Value	Specification 4 Odds Ratio	p-Value
antenatal (doctor)	1.29	0.232	1.32	0.239	1.38	0.170	1.37	0.184
antenatal (midwife)	0.90	0.653	0.97	0.889	0.94	0.800	0.90	0.665
antenatal (traditional)	0.67	0.348	0.70	0.434	0.71	0.449	0.72	0.475
antenatal (None)	1.39	0.306	1.38	0.337	1.34	0.384	1.32	0.409
took no tetanus injection*								
Tetanus injection	0.90	0.087	0.90	0.101	0.91	0.118	0.90	0.099
antenatal visit began at 1-3 months*								
4-6 months	1.01	0.946	0.98	0.937	0.96	0.858	0.94	0.760
7-9 months	0.75	0.309	0.64	0.137	0.62	0.110	0.60	0.086
Pregnancy complications (not told where to go)*								
told where to go	0.45	0.078	0.42	0.060	0.41	0.053	0.42	0.064
Not told of pregnancy complications*								
told of complications	1.64	0.267	1.88	0.170	1.92	0.155	1.83	0.195
Took no malaria drug*								
took malaria drug	0.92	0.567	0.82	0.208	0.84	0.250	0.85	0.312
Weight for height (100-120: WHO ref.)*								
weight for height (<100)					1.16	0.325	1.16	0.347
weight for height (>120)					0.67	0.009	0.67	0.011
height (150-160 cm)*								
height (<150)					1.51	0.043	1.48	0.058
height (>160)					0.90	0.426	0.91	0.522
No smoking*								
smokes1					1.20	0.753	1.14	0.826
No family planning*								
family planning (folkloric)							0.59	0.352
family planning (traditional)							0.72	0.512
family planning (modern)							1.09	0.756
preceding birth interval (2-3 years)*								
< 2 years							1.18	0.364
more than 3years							1.20	0.239
Higher order births*								
first birth							1.05	0.778
age at first birth (15-19 yrs)								
below 15 yrs							0.97	0.819
20 yrs and above							0.92	0.748
Male*								
Female							1.58	0.000
No flush toilet*								
flush toilet			1.28	0.523	1.27	0.541	1.42	0.387
No public tap*								
public tap			1.71	0.052	1.71	0.057	1.75	0.048
South-south*								
north central			0.80	0.466	0.83	0.543	0.86	0.614
north east			0.80	0.491	0.80	0.505	0.85	0.634
north west			0.54	0.061	0.54	0.065	0.56	0.082
South-east			1.45	0.280	1.40	0.333	1.44	0.300
south-west			0.65	0.203	0.63	0.175	0.65	0.220
Poorest*								
Richest			0.51	0.095	0.57	0.172	0.58	0.197
Richer			0.56	0.012	0.60	0.027	0.61	0.035
Middle			0.41	0.000	0.42	0.000	0.42	0.000
Poorer			0.63	0.003	0.65	0.005	0.64	0.005
No education/incomplete primary*								
complete primary			1.19	0.390	1.23	0.315	1.22	0.328
incomplete secondary			1.58	0.068	1.65	0.048	1.59	0.072
complete secondary			1.09	0.809	1.15	0.693	1.12	0.753
higher			1.86	0.211	2.03	0.156	1.98	0.178

Does not take part in decision making*							
takes part		0.71	0.061	0.73	0.076	0.74	0.102
Catholic*							
Protestant		0.94	0.829	0.95	0.861	0.97	0.916
other Christian		1.80	0.048	1.76	0.058	1.72	0.069
Islam		2.59	0.001	2.44	0.002	2.40	0.003
Traditionalist		3.99	0.002	3.90	0.002	4.54	0.001
Observations	2183.00	2182.00		2182.00		2182.00	
Pseudo-R2	0.01	0.05		0.06		0.07	
Prob>chi2	0.00	0.00		0.00		0.00	

Note: the t-statistics are based on robust standard errors. P-value is significant at least at 10% level. * Reference categories.

a. Specification 1: prenatal care variables alone
b. Specification 2: specification 1 and socio-economic indicators
c. Specification 3: specification 2 and maternal nutrition variables
d. Specification 4: specification 3 and demographic variables. Specification 4 forms the final model

The link between maternal placental infections and birth weight thus implies that strategies that alleviate the incidence of these infections (such as maternal tetanus toxoid injections) may in turn negatively impact on the incidence of small size at birth and therefore must be strengthened. This strong link (found in this study) between tetanus toxoid injection and size of baby at birth has never been demonstrated by any study in Nigeria, which therefore distinguishes the present study. This observed effect in Nigeria may be as a result of the country-wide Expanded Programme on Immunization (now National Immunization Programme). Future research on the pathways through which maternal tetanus toxoid injection impacts on birth weight is therefore proposed.

Information on pregnancy complications

In urban areas (Table 7), women who were told of where to go for pregnancy complications (a precautionary measure; it is assumed that when complications arose, these women heeded to these precautions) are associated with a 47%-53% reduction in the odds of giving birth to small infants. On controlling for the socioeconomic indicators in specification 2, it became insignificant as socioeconomic factors tend to trump the effect of antenatal care. In rural areas, babies born to mothers who were told about where to get attention for pregnancy complications had about 55-59 (%) reduction in the odds of being small at birth compared to those who mothers did not receive this type of antenatal education. They remained significant across all four specifications (see Table 8, specification 1-4). On controlling for the socioeconomic indicators in specification 2, the magnitude of their effects did not change. In general, the regression results suggest that women who knew where to go for pregnancy complications were less likely to deliver small babies. This also is consistent with Alexander and Korenbrot (1995) and Rahan and Tafada (1981) who found that antenatal care is a means of identifying high risk pregnancies to reduce the incidence of low birth weight.

Timing of antenatal visit

Timing of antenatal visit in urban areas has no significant association with birth size. However, the results suggests that in rural areas, the odds of delivering small babies for those who began their antenatal visit within 6-9 months of gestation was lower than those whose visit began in 4-6 months or less. Although the literature (Conrad et al. 1998) have shown that it is antenatal visits in the 1-3 months that is significantly associated with better birth outcomes, the observed results for Nigeria may not be surprising as multiple antenatal care registrations which is often observed among pregnant mothers in the country may impair the reliability of data on timing of antenatal care visit. This pattern suggests that the beneficial effect of this factor on size at birth is large when the reproductive health of the population is poor and it argues for programmes focused on specific populations at risk.

However, the failure to demonstrate a substantial beneficial effect of early antenatal visit on size at birth in the present study may be due to errors in methods of data collection. This might not have been designed properly to sieve issues of: (i) multiple registrations in different antenatal clinics and (ii) recall bias where only very recent or near delivery antenatal visits are reported by respondents. Also, this study is unable to find any evidence to support the argument that a doctor-attended antenatal care is negatively linked to the incidence of small size at birth. This may seem surprising, especially, given the importance attached to doctor and midwife attended care in the study area. As discussed in chapter 3, this may be related to the poor working conditions under which health personnel in Nigeria operate which in turn led to several strike actions in year 2000 and emigration of health personnel at high human costs. A positive association of inadequate prenatal care and small birth size has been confirmed by Coria-Soto et al. (1996).

Socioeconomic status (SES)

In urban areas, having controlled for other variables in specification 4 (the final model), only mothers from richer households had 51% reduced odds of giving birth to small sized babies compared to mothers from poorest households. This deficit can be attributed among others to the poorer utilization of antenatal care among poor women. The latter should not be surprising because it has been observed (Butz et al. 1993, Mustard & Roos 1994) that there is a positive correlation between maternal SES and access to antenatal care. Thus antenatal care constitutes the central medium through which socioeconomic status and women's reproductive behaviour operate to influence size of a baby at birth (Greenberg 1983, Magadi et al. 2004). This is in line with the second school of thought regarding the role of antenatal care on low birth weight (section 3.1). Only women from wealthier homes tend to use antenatal services more often and on time than others. This may imply that free antenatal care services may remove most barriers to access.

However in the rural areas, all categories of women in the wealth index had significantly reduced odds for delivering small babies compared to the poorest groups of women. These variables remained significant across all three specifications (see Table 8, specifications 2-4). For babies born to women from poorer households, the odds of being born small reduces by 35% than poorest households and for middle-income households, the odds of being born small

reduces further by 58% than babies born to poorest households. But for babies born to women in richer households, the odds of being born small are reduces by 39%. It may mean that it is quality of antenatal care indicators (tetanus injection, women told where to go for complications), which most times is provided free of charge independently impact on the size of a baby as even poorer women had reduced probability of having small babies at birth as there is no difference in the occurrence of small sized births between the poor and richer women.

Also, there are basic trado-local practices of antenatal care management which rural-based women are exposed to by default (Adetunji 1996). Invariably, women living in these areas benefit from precautionary care where they do not have access to antenatal care either by reason of SES or mere absence of such health facility in the rural areas. This in turn confirms also the first school of thought that antenatal care has a direct relationship with size of a baby at birth (section 3.1). Notwithstanding, other underlying factors not controlled for in this study such as cultural and maternal behavioural factors, and perception of antenatal care services may be driving the use of antenatal care services.

Having tested the validity of the proposed schools of thought in this study, it is therefore necessary to state that the results from this study adds to the literature on the role of prenatal care on birth size by finding that in Nigeria, antenatal care independently impacts on the size of a baby at birth in rural areas. However, in urban areas, it is the mothers' SES that matters and antenatal care is the medium through which the SES impacts on birth size. Thus the role of prenatal care in determining size at birth is dependent on the type of place of residence of the woman. Hence, more research specifically tied to either a rural or urban place of residence is proposed to further test the wideness of this finding in other countries.

Other socioeconomic indicators such as the region of residence show that in urban areas, among babies of the north-central and south-south regions, the odds of being born small are increased by 141% and 118% respectively. But in the rural areas, among babies of the North West region, the odds of being born small are reduced by 44% (contrary to the 2003 DHS simple percentages). The sitting of international donor-funded health care programmes which favoured most of the rural north may be responsible for the observed effect in the rural North West.[14]

However in rural areas, the association between the region of residence and the incidence of small size at birth may not necessarily be picking up the effect of region but may indicate the significant role played by religion. Religion has a very large effect on the incidence of small-sized babies in rural areas (see Table 8, specification 2-4), although Oladipo and Osiberu (2008) finds the contrary for Sokoto state, Nigeria. The results from the present study shows that being traditional worshippers, Muslims and women in 'other Christian' categories increased the odds for small size at birth by 299%, 159% and 80% respectively compared to catholic women. Religion plays a very significant role in a woman's access to health care in the Nigerian context. For example, the

[14] International donor-sponsored antenatal care programmes (USAID, EU, Pathfinder Int.) and those of the Nigerian government heavily favoured the rural northern areas that had generally exhibited poor health outcomes prior to the 1990s. This relative concentration of medical aid to the rural areas of the north might have, by extension, improved birth outcomes amidst other indicators of improvement in health service delivery.

Muslim practice of 'purdah' (wife seclusion) restricts women's access to medical care (Wall 1998). This male social control (however with few exceptions) associated with 'purdah' constrains their women's ability to personal autonomy, a fact that permeates almost every aspect of the Hausa life and are associated with many of the maternal health problems. This delay in seeking medical care has far-reaching consequences on women's health in Northern Nigerian Muslim societies (Shehu 1992). The delay might have been the result of initial reliance on adherence to religious tenets, which were recommended as factors of successful pregnancy outcomes. However when the religious paths looks like failing, the attention of doctors are sought as emergency options, late in the gestation period. Invariably, religion this way becomes a hindrance rather than an enabling factor for such women. At such stage, doctors could at best offer services that guarantee survival of mother and foetus/child rather than increase size of babies at birth (e.g. in the event of pre-term births). It was observed earlier that there is a positive association between small birth size and doctors' attendance of antenatal care.

There is a positive association between 'other Christians' (spiritual churches), traditionalists and small size at birth. This could be attributed to the women's fear of spiritual attack by wicked forces against successful gestation. Here, prophetic warnings are given in these spiritual churches with recommendations of fasting and prayers in place of adequate antenatal care as a better measure and solution to pregnancy complications. This is consistent with results of Etuk et al. (1999) in their studies on Antenatal clinic default in Calabar, south-south of Nigeria.

The relationship between maternal education and birth size is inconsistent from previous studies. While some have shown an inverse relationship with pregnancy outcomes (Ebimoyi et al. 1991, Karim and Mascie-Taylor 1997, Tuntiseranee et al. 1999), others have shown a relationship in the opposite direction (Prazuck et al. 1993), yet others have not found any of such relationships (Bener et al. 1996, Peabody and Gertler 1997). In rural Nigeria, babies whose mothers have incomplete secondary educational attainment is associated with about 41% increased odds of being small at birth compared to those with incomplete or no primary education, that is a negative association with birth size. This observation in Nigeria may have arisen because of the economic down-turn in the 1990s and early 2000, which escalated unemployment rate among women with secondary education;[15] Adetunji (1995) confirms this relationship in the study for child mortality in Nigeria. Similar results (Prazuck et al. 1993) have been observed for most sub-Saharan African countries. Studies which have found a negative association may have done so because they often use hospital data.[16]

[15] There was as upsurge in the number of secondary school graduates as a result of the universal primary education (UPE) introduced in the south western region of Nigeria in 1955 and reduction in secondary education fees which other regions (except the north) adopted few years later.

[16] Hospital-based data, especially those from developing countries tend to be selective since it is not all socio-economic sub-groups of women that are represented and some are only likely to visit health facilities when such complications are developed. Such sub-groups will naturally have higher risks of unfavourable pregnancy outcomes irrespective of who directed their antenatal care visits. Another reason for inconsistent results could be the statistical procedures employed in the analysis for these studies. When analyses do not take confounding factors into account, it may lead to spurious results.

Mothers' status in decision-making

Status of the mother in decision-making regarding own health (as discussed in chapter 3) is expected to have a negative impact on the incidence of delivering small infants.[17] Consistent with expectation, in rural Nigeria (Table) regardless of the specification, babies whose mothers have better status in the household (in terms of decision making) had about 26% reduced odds of being born small. This is consistent with Oxaal and Baden (1996). Mothers in households that have a flush toilets in urban areas have a 40% decrease in the risk of giving birth to small-sized babies.

Maternal nutritional status

Maternal nutrition appears also to be a very important determinant of the baby's size at birth in this study. It has a direct causal impact on the incidence of small size at birth. This strong link has been demonstrated by other studies. Ogunjuyigbe (2000) and Ogunjuyigbe et al. (2008) identified maternal nutrition as the most important determinant of adverse pregnancy outcomes in Nigeria. Similar results have been observed for Kenya (Magadi et al. 2000); Thailand (Tuntiseranee et al. 1999); Canada (Kramer 1998); Bangladesh (Das and Khanam 1997) and western Central African Republic population (Anderson and Bergstrom 1997).

In the present study, mothers with high weight for height score (>200) and taller mothers (>160cm in height) are less likely to deliver small babies than mothers with low weight for height score and shorter mothers. For babies born to taller mothers, the risk factor of being born small decreases by 28% in urban areas (see Table 7, specification 3 & 4) and compared to babies born to shorter mothers (<160cm) and there is a 49% increase in the odds of being born small for babies whose mothers have a small stature in rural areas (see Table 8, specification 3 & 4). Being born to a mother with a high weight for height in rural areas reduces the odds of being born small by 33%. However, in urban areas, the effect is not statistically significant although babies born to mothers with a low weight for height scores (less than 100) are more likely to be small compared to those born to mothers with average or high weight for height scores (>100). It should be noted however that mothers with high weight for height score, seemed less likely to report the baby size as small when birth weight information are available. It is important to note that the association of maternal weight and size at birth in this study could be influenced by inconsistencies in mothers' reporting by her nutritional status.

Demographic risk factors

The final specification in Tables 7 & 8 includes demographic indicators. The results were not statistically significant, but were consistent with expectations; the risk factors for first births to result in small babies are higher compared to other births and there is a higher risk of giving birth to small babies for mothers whose preceding birth intervals are less than two years or higher than

[17] Thus issues of maternal health can be approached from a 'rights-based' rationale or a 'health/welfare' approach. International conferences such as the Beijing conference has emphasized how important women's reproductive and sexual rights are as well as the complex cultural, political, social and economic factors that underlie them.

two to three years. Consistent with expectations, sex of a baby in this study has a direct causal effect on the incidence of small size at birth. Female babies are more likely to be born small than their male counterparts with an average odds ratio of 1.6.

Chapter 6

CONCLUSION

The study provided a direct test of the validity of the two schools of thought regarding the role of prenatal care on low birth weight. The results of this study, although are to a large extent consistent with findings from previous studies regarding factors that affect the size of a baby at birth, provides new findings for the literature on birth weight.

This study critically explored the relationship between antenatal care and size of a baby at birth with and without adjusting for socioeconomic indicators. While previous studies on low birth weight in Nigeria have considered the role of prenatal care, maternal nutrition, age and other socioeconomic factors using hospital data, this study is based on a representative and recent DHS survey data for 2003. In addition to the difference in data source, this study provides some results that extend the existing literature. First; having tested the validity of the two schools of thought in relation either to the importance of the linkage of prenatal care and/or socioeconomic status of the women to birth weight of babies, I found that in rural areas, with respect to the first school of thought (section3.1), antenatal care (tetanus toxoid injections) was independently observed to be negatively associated with the incidence of small size at birth even after adjusting for socioeconomic status (SES) as there was no difference among the rich or poor women with respect to incidence of small size at birth and so antenatal care was not picking up any SES effect. On the contrary, the hypothesis regarding the second school of thought (section 3.1) was observed to be true for women in the urban parts of Nigeria. The results showed that richer women had better birth outcomes; hence the SES of the mother was more important in determining her baby's birth size. This was attributed to the better utilization of antenatal care among richer women and as such antenatal care (tetanus toxoid injections and being told about where to go for pregnancy complications) was the medium through which the SES of the mother impacted on her birth outcome. This suggests the need for affordable antenatal care in urban areas.

Therefore study to the existing literature, firstly that, there is a strong and direct association between antenatal care (tetanus toxoid injections) and birth size of a baby in the rural areas of Nigeria. Secondly, the SES of the mother (which is highly correlated with antenatal care) impacts on her birth outcomes through better utilization of antenatal care services in the urban areas. Hence, antenatal care constitutes the central medium through which socioeconomic status operates to influence size of a baby at birth. Specifically, among the antenatal care variables controlled for, women who took tetanus toxoid injections and those who were told of where to go for pregnancy complications were less likely to deliver babies with small sizes.

The role of maternal nutrition cannot be over-emphasized as mothers with high weight for height scores (>120) and taller mothers (>160cm in this case) were negatively associated with small size at birth. Region and religion appeared to be important factors determining antenatal care utilization and thus small size at birth. This observed association between the odds of small

size at birth and religion suggest the need for more advocacy programmes targeting Muslim religious leaders in the urban north central region, traditional and 'spiritual churches' leaders in urban south-south parts of Nigeria and educating them on the implications of delivering small infants and what role attendance to adequate antenatal care would play if they encourage their pregnant women to attend. These will help create awareness and avoid preconceived misconceptions regarding antenatal care.

The successful usage of birth size as a proxy for birth weight (although a weakness of the study), implies that in the absence of birth weight information in DHS surveys for future studies, analysis can be carried out on size at birth information. It also has implications for the improvement of data collection and availability in the Nigerian health sector. Irregular measurement of birth weight data in Nigeria may be simply due to reasons of relative faulty weighing scales, therefore we could encourage the incorporation of the collection of birth size information in birth registers (in health centres and/or local birth registry especially as not all births are born in hospitals/clinics). The apparent ease of availability of this information in NDHS records indicate a willingness on the part of both women (respondents) and interviewers or health workers to readily provide the necessary statistics. This will ultimately be useful for feedback process in relation to health policy modification.

In general, quality of antenatal care, maternal morbidity status, and appropriate maternal nutrition, socioeconomic status of mother, religion and availability of flush toilet are all important in reducing the incidence of small size at birth.

Policies that ensure improvement in the quality of antenatal care and programmes aimed at: increasing routine tetanus toxoid injection coverage against maternal tetanus infections, promotion of a lifestyle that will prevent development of tetanus infection among pregnant women, maternal nutritional programmes that focus specifically on high-risk groups such as multiple and first births, female births and poor women as the results suggest are necessary. Affordable antenatal care services may be necessary and pregnant women may be provided access to credit to assist them in their accessibility to antenatal care. However, any strategy to enhance accessibility to and utilization of antenatal care which will in turn improve birth outcomes must be sensitive to regional disparities and will have to confront existing notions of a culturally and religiously acceptable antenatal and reproductive health practices in these regions.

There is therefore a need for further research on first, an in-depth study on the impact of tetanus toxoid injection on birth size is necessary. Second, qualitative studies on mothers' cultural and behavioural factors determining their utilization of prenatal care services are proposed based on the impact of religion in the present study. Third, studies should be geared towards addressing the self-selection bias limiting interpretation of results in this area of research by using experimental data. Fourth, exploring the validity of the two schools of thought regarding the role of antenatal care separately in rural and urban areas and the pathway through which these birth size determinants influence it is necessary to avoid confusions in interpreting results and to further test the applicability of the finding from this study to other countries. In addition, there is a need to explore the extent to which the incidence of low birth weight could be reduced by giving to all prospective mothers access to antenatal care but keeping constant their other socio-

economic characteristics. Finally, models such as the multilevel models which better adjusts for the clustered nature of the DHS survey data are proposed.

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APPENDIX

Table A.1
Selection effect for missing and non-missing data

Variable	Incomplete cases (missing variables) Mean	Std. Dev.	Complete cases (no missing variables) Mean	Std. Dev.
Antenatal care (doctor)	0.12	0.33	0.33	0.47
Antenatal care (midwife/nurse)	0.28	0.45	0.80	0.40
Antenatal care (traditional)	0.03	0.16	0.04	0.20
Antenatal care (None)	0.62	0.49	0.00	0.00
Tetanus injection*	0.15	0.36	0.83	0.38
Trimester visit began	4.60	1.75	4.67	1.58
Told where to go for complications*	0.09	0.28	0.56	0.50
Told of pregnancy complications*	0.09	0.29	0.59	0.49
Took malaria drug during pregnancy*	0.13	0.34	0.55	0.50
days took iron syrup during pregnancy(<100)	0.66	0.47	0.58	0.49
>100	0.24	0.43	0.32	0.47
Do not know	0.10	0.30	0.10	0.29
Weight for height (WHO ref. median)	115.86	20.67	121.23	23.18
Height (cm)	158.02	6.16	159.05	5.95
Smokes*	0.01	0.09	0.01	0.09
family planning (no method)	0.88	0.32	0.78	0.42
family planning (folkloric method)	0.02	0.12	0.01	0.10
family planning (traditional method)	0.02	0.15	0.06	0.24
family planning (modern method)	0.08	0.27	0.15	0.36
Single birth*	0.96	0.21	0.97	0.17
Preceding birth interval (months)	34.49	19.28	39.44	23.54
Birth order	3.79	2.78	4.76	2.42
Maternal age at first birth	18.36	3.93	19.02	3.87
Female*	0.49	0.50	0.50	0.50
Flush toilet in house*	0.08	0.27	0.16	0.37
Water facility in house	0.08	0.27	0.11	0.31
Wealth index	2.64	1.36	3.34	1.39
Mother's educational attainment	1.12	1.50	1.78	1.60
Mother's status	0.19	0.39	0.31	0.46
Catholic	0.10	0.30	0.12	0.33
Protestant	0.11	0.32	0.19	0.39
Other Christians	0.12	0.32	0.19	0.39
Muslim	0.65	0.48	0.48	0.50
Traditional	0.02	0.13	0.02	0.13
Urban	0.31	0.46	0.46	0.50

* Reference categories.

Table A.2
Odds ratio for small size at birth by antenatal care, socioeconomic and demographic indicators for women who delivered live-birth singletons in urban and rural areas five years preceding the 2003 DHS (including days syrup was taken)

		Specification 4		
Variable	Odds Ratio	p-Value	Odds Ratio	p-Value
	Urban		Rural	
antenatal (doctor)	1.09	0.736	1.60	0.097
antenatal (midwife)	0.86	0.618	0.85	0.584
antenatal (traditional)	1.49	0.578	0.40	0.198
antenatal (None)	0.84	0.801	1.10	0.850
took no tetanus injection*				
tetanus injection	0.78	0.009	0.89	0.150
antenatal visit began at 1-3 months*				
4-6 months	0.83	0.447	0.91	0.695
7-9 months	0.80	0.557	0.67	0.251
Pregnancy complications (not told where to go)*				
told where to go	0.74	0.563	0.29	0.021
Not told of pregnancy complications*				
told of complications	1.32	0.610	3.06	0.039
Took no malaria drug*				
took malaria drug	1.20	0.421	0.86	0.458
Days took iron syrup (>100 days)*				
100 days	0.99	0.956	1.24	0.426
don't know	0.88	0.764	0.96	0.927
Weight for height (100-120: WHO ref.)*				
weight for height (<100)	1.13	0.686	1.02	0.941
weight for height (>120)	0.81	0.402	0.59	0.024
height (150-160 cm)*				
height (<150)	1.15	0.791	1.36	0.403
height (>160)	0.93	0.740	0.78	0.268
No smoking*				
smokes1	1.65	0.684	3.98	0.073
No family planning*				
family planning (folkloric)	.....	.....	1.25	0.768
family planning (traditional)	1.40	0.390	0.51	0.316
family planning (modern)	1.05	0.864	1.42	0.268
preceding birth interval (2-3 years)*				
< 2 years	1.29	0.470	0.97	0.932
more than 3years	1.47	0.167	0.78	0.323
Higher order births*				
first birth	0.94	0.822	1.61	0.104
age at first birth (15-19 yrs)				
below 15 yrs	1.09	0.753	0.93	0.756
20 yrs and above	1.54	0.161	0.91	0.775
Male*				
Female	1.71	0.013	2.44	0.000
No flush toilet*				
flush toilet	0.60	0.113	1.76	0.216
No public tap*				
public tap	0.79	0.419	1.19	0.711
South south*				
north central	2.70	0.012	1.04	0.923
north east	1.67	0.208	1.11	0.824
north west	1.01	0.978	0.31	0.019
South-east	1.94	0.178	1.54	0.308
south-west*	2.39	0.058	0.95	0.905
Poorest*				
Richest	0.75	0.644	0.70	0.481
Richer	0.61	0.391	0.78	0.466
Middle	0.46	0.181	0.56	0.055
Poorer	1.31	0.648	0.67	0.158
No education/incomplete primary*				
complete primary	0.93	0.827	1.53	0.132
incomplete secondary	1.35	0.349	1.64	0.122

complete secondary	0.98	0.952	0.84	0.706
higher	0.99	0.990	2.05	0.203
Does not take part in decision making*				
takes part	0.71	0.209	0.63	0.091
Catholic*				
Protestant	1.09	0.831	1.25	0.580
other Christian	0.64	0.304	1.71	0.175
Islam	1.01	0.975	2.51	0.035
Traditionalist	0.59	0.573	3.78	0.077
Observations	927.00		1099.00	
Pseudo-R2	0.07		0.12	
Prob>chi2	0.26		0.00	

Note: the t-statistics are based on robust standard errors. P-value is significant at least at 10% level. * Reference categories.

Figure 4
Map of Nigeria's six geopolitical zones